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Historical Social Research, Vol. 30 — 2005 — No. 3, 265-285

Living Conditions During Childhood and Survival in Later Life – Study design and First Results

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Abstract: During the last decades, the life course approach to human survival has become a central topic in epidemiology and demography. Although in theory a prospective birth cohort study is the most appropriate research design for this kind of study, data problems have made this approach practically unfeasable. In our paper we present the main outlines of a project in which we use a prospective cohort design for a historical population. The project is based on a historical data-set for three provinces in the Netherlands, covering a time period from the mid-nineteenth to the early twenty-first century. Our study focuses in particular on the impact on survival to adulthood and old age of three specific conditions during infancy and childhood: the socio-economic condition of the family, the composition and structure of the family and the physical environment in which children spent the first part of their life. We briefly sketch the theoretical backgrounds of our study, discuss the data collection strategy and the study area, and present the first results of an analysis of a part of the data-set that recently became available.

Introduction

During the last decades, the effect of physical and social exposures during gestation, childhood and adolescence on health and mortality in later life has become a central issue in epidemiology and demography (Kuh and Ben-Sholomo 1997; Ben-Shlomo and Kuh 2002).

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Acknowledgement: We gratefully acknowledge a grant from the National Institute on Aging (1P01AG18314), which supported the research reported here.

Recently, Ben-Shlomo and Kuh (2002) have given an overview of the problems, challenges and perspectives of this so-called life course approach to human health. Three issues they consider particulary important in designing studies in this field. The first is a clear conceptualisation of the temporal ordering of exposure variables (such as insufficient nutrition, low socio-economic status) and outcome measures (health, survival).[1] The second is the need to apply life course approaches over different generations to find out whether the relationships between exposure and health outcomes vary over time. The third is the necessity to include in life course approaches risk factors operating at a variety of hierarchical levels, at the national, neighbourhood and household level (that is using multi-level models).

To study the effects of conditions in early stages of life on health at older ages, a variety of approaches has been followed. Some studies have been based on discoveries of populations studied in early life but not later, and investigators then tried to find these populations in adult life in order to study their health and survival in relation to the recorded early developmental measures and exposures. These catch-up designs rely on recollection for data in the years between childhood and the first adult recontact. Many studies have been based on subjects that are recruited in mid-life and are followed up for future disease or death. Information on early life exposure such as socio-economic position during childhood here is usually collected retrospectively. Retrospective data on childhood conditions have a high risk of biased information and are only based on the surviving part of the cohort, which might give rise to selection effects. In theory, a prospective birth cohort study is the most appropriate research design. However, the results of these studies become available only after a long time. In addition to that, they have a very high non-response and loss to follow-up which becomes more important as the study period is longer, that is precisely when the effect of childhood conditions on later ages might come to light (Wadsworth et al. 2003).

We present here the design of a project called *Inequality in longevity from a life-course perspective: The Netherlands 1850-2000* in which we use a prospective cohort design for a historical population. The project is based on a historical data-set for three provinces in the Netherlands, covering a time period from the mid-nineteenth to the early twenty-first century. Our study focuses in particular on three specific conditions during infancy and childhood and their impact on health in adult life: the socio-economic condition of the family in which the child is born and raised, the composition and structure of the family in which the child lived and the physical environment in which

[1] Exposure during early life might be linked to later health outcomes in various ways. Two basic models can be distinguished: a critical period model, based on the idea that an exposure in a critical period results in permanent or irreversible damage to health (models may include or not later life risk factors or later life effect modifiers) and an accumulation of risk model, in which factors that raise disease risk may accumulate over the life course.

individuals spent the first part of their life. Survival in adult life is the outcome variable in which we are interested. The passage of time, individual and social, plays a crucial role in the proposed study: this will allow us to study changes over time in the importance of specific stages in childhood, or in the relative importance of exposure characteristics such as social class. We also include risk factors at the national, regional and individual level.

Of course historical prospective cohort studies of the kind proposed here have also serious shortcomings: they have very limited or no data on biological or psychosocial exposures and the only outcome variable about which information is available is usually death. Therefore it is very difficult to draw conclusions about the pathways via which exposure affects outcomes (biological, social or a combination of the two). We will briefly sketch the theoretical backgrounds of our study, discuss the data collection strategy and the study area, and present the first results of the analysis of a part of the data-set that recently became available.

The relation between childhood circumstances and adult health and mortality

There are three specific childhood conditions for which we want to study the long-term health consequences. The first of these is the socio-economic status (SES) of the family in which the child grew up. It is a well-known fact that people in lower socio-economic positions are generally worse off with respect to their health than people in higher positions. These socio-economic inequalities in health exist from the first year of life on (Kunst et al. 1994a, 1994b). Several authors have argued that socio-economic health differences in adult life are partly explained by processes much earlier in life, in particular by childhood socio-economic conditions (Davey Smith et al. 1994; Lundberg 1991; Lundberg 1993; Wadsworth 1997). Following a British study (Kuh and Wadsworth 1993), Van de Mheen et al. (1997, 1998) for example showed that a substantial part of the differences in health between educational and occupational groups in age group 25-74 years could be attributed to economic differences in childhood environment, such as position of the father in the labour market, occupational level of the father and financial situation.

How exactly childhood SES and adult mortality are linked is still unclear. One of the problems is that socio-economic differentials in mortality during adult and old age might be the effect of health-related selection of persons into socio-economic categories (Mare 1990). Adult mortality might be the effect of adult socio-economic status which in its turn is determined by childhood health. Another problem relates to the question whether there is a cumulative effect of negative socio-economic exposures over the life time (see for example

Davey Smith et al. 1994), implying that the longer a person is exposed to poor circumstances, the greater the health risks become. Some authors have argued that experiences in the remote past may decline in importance as time passes.

A second dimension of the childhood environment that might have an influence on later survival of the child is the structure of the family in which the child grows up. A growing body of historical literature now exists on the short-term negative consequences for the survival of children born outside marriage or growing up in a family which has undergone the death of the parent or a divorce (Van Poppel 2000; Reher and Gonzáles-Quiñones 2003; Derosas and Oris 2002). Several present-day studies have been published which observed significant effects of family disruption during childhood on health later in life. Lundberg (1993) found that living with only one parent up to age 16 was significantly associated with self-reported poor health in adulthood. Preston, Hill and Drevenstedt (1998) observed that children living in households headed by their mothers had slightly higher probabilities of survival to age 85 than those with father heads. Modin (2003) showed that men born to unmarried mothers had a higher ischaemic heart disease mortality than men born to married mothers. Smith et al. (unpublished) found that children who had experienced the death of one or both of their parents before the child had reached age 20, had excess mortality in particular during early and middle adulthood. Long-term effects of parental divorce on mortality before children had reached age 18 were found in a Swedish study, where those who had divorced parents had relative risks which were 30 percent higher than the reference group, after controlling for factors such as social class, income, and well-being (Hansagi, Brandt and Andréasson, 2000).

Especially in historical societies one might expect strong effects of family structure on survival of children. In nineteenth-century European societies the state played only a minor role in allocating the resources that were essential for family members' quality of life. The family situation and the family assets therefore determined to a much larger extent the life chances of the family members, in particular those of the children (Cunningham 1995, pp. 79-106). The question that we want to address is whether the family situation also had an effect on survival in later life.

The potential effects of childhood living conditions on survival in later life also depend on the characteristics of the wider environment in which the child grows up, that is on the epidemiological regime characteristic of the area. Historical as well as contemporary studies have shown that the specific spatial context in which groups of individuals are living—for example the socio-economic status of the residential area—has a strong association with the mortality level, net of individual-level characteristics (Hummer, Rogers and Eberstein 1998). Bosma et al. (2001) for example showed that living in areas characterised by poor socio-economic conditions had negative effects on health for both people with a high and those with a low socio-economic status. Various

historical studies have reached the same conclusion, the most convincing ones being those of Garrett et al (2001). These authors demonstrated how strongly social inequality in childhood mortality depended on the ecological and social situation of the area in which the family lived. Several studies have analysed whether area characteristics have also long-lasting effects on mortality. Coggon et al. (1990; 1997) found that regional mortality levels of stomach cancer in England reflected influences from both the county of birth and the county of residence. The association with place of birth was found in migrants both out of and into high-risk areas. Wannamethee et al. (2002) used information on migration status of middle-aged men in Great Britain and found that region of birth and region of examination had an effect on cardiovascular disease mortality.

In particular when migrants move from regions of high mortality to regions of low mortality or vice versa, migration provides a setting in which the impact of environmental factors during childhood on mortality later in life can be investigated. The Dutch situation provides an excellent opportunity to do so. Large regional differences in mortality characterised the country in the 19th and early 20th century, and these factors were strongly related to different epidemiological regimes. To study whether the later life survival of migrants is determined by influences stemming from the region of origin mortality risks among migrants have to be compared with those of the non-migrants from the region of origin and with those of the native population of the region of destination (Brockerhoff 1994). Time since departure is essential in studying the mortality consequences of migration. Some of the early-life influences may disappear soon upon arrival in the new area but others will retain their influence for a longer time. In general these factors tend to diminish over time as the effect of past exposures wear off and as behavioural patterns become more similar to those of the host region (integration or assimilation). Mortality trends among immigrant groups are also influenced by selection processes. Due to health selection at migration, the immigrant population might be relatively healthy and their risk of dying low during the first years after migration.

Time, individual as well as social, plays a crucial role in studying the long-term effect of the socio-economic position on survival, that is the child's family, its composition and structure and the spatial characteristics of its area of birth. As far as individual time is concerned, it is important to realise that the length of time during which children were in advantaged or disadvantaged positions might play an essential role that has to be taken into account explicitly. Taking into account the passage of social time is at least just as important. Possible changes over time in the importance of specific stages in childhood, or in the relative importance of characteristics such as the presence of both parents occupy a prominent place in our study. Changes over time have occurred in all three areas of interest in our study. As far as the potential effect of the family composition is concerned, mention can be made of the increase in the role that

mothers in comparison to fathers played in rearing their children, and to the decreasing importance of the role of the family in comparison to that of state and school (Janssens 1997). This loss of function might have changed the relative importance of fathers and mothers for the survival of children and may have affected the long-term impact of familial circumstances at the time of birth. Changes also took place in opportunities for social mobility, causing changes in the long-term longevity effects of socio-economic position. Greater equality in epidemiological regimes within the country lessened the role of region of birth over time. Only by applying a wider time perspective the changing weights of the selected childhood conditions might be studied in a satisfactory way.

The Historical Sample of the Population of the Netherlands

To analyse the long-term effects on survival in later life via/by the socio-economic situation of the child during childhood, its family situation and the region of its residence we will make use of data that come from the so-called Historical Sample of the Population of the Netherlands (HSN). The aim of this project is to build a national database with information on the complete life history of a 0.5 percent random sample (76,700 birth records) of men and women born in the Netherlands between 1812 (the introduction of the vital registration system) and 1922. In all Dutch provinces a random sample of births was drawn which was stratified by period of birth (11 periods) and level of urbanisation of the municipality (Mandemakers 2001). These births were followed over their whole life course till death or to the present-day if still alive.

To study the effect of early-childhood on longevity, only a selection of data from the HSN-database can be used. The study is restricted to three of the eleven Dutch provinces—Zeeland, Utrecht and Friesland—and to children born between 1850 and 1922, giving a total of 6,975 births rather evenly distributed over the three areas. The selection of the provinces is mainly based on the fact that in these three provinces, the collection of information has progressed most. The restriction to cohorts born in the period 1850-1922 is motivated by the fact that information that is central to our study—information on the family structure during childhood and on area of birth and area of residence later in life—can only be collected by using a source of information that is available from 1850 on, viz. the population register. We will come back to this issue when discussing the data.[2]

[2] The HSN started in early 1991. The project that is discussed here started on July 1st 2001 and data-collection will be completed around September 2005.

The three selected provinces were clearly distinct from each other in economic, social, and demographic aspects during the nineteenth and early twentieth century. First and foremost, the three provinces can act as a perfect illustration of the sharp divide that existed until the 1880s between the high mortality levels of the coastal and low-lying riverine municipalities and the low levels of the upland area in the North, East and South (Van Poppel and Beekink 2002). [3]

For the three provinces as a whole, the sample will contain 6,975 births. At this moment only for Zeeland life courses have been collected and entered for almost the whole province. For Utrecht and Friesland information on the family situation and the life course (including migration) will be available on March 1, 2005. The discussion here will thus be restricted to the results of Zeeland only, a coastal province located in the delta of the rivers Rhine and Maas.[4]

Data collection

To reconstruct the life history of the individuals in our sample use is made of two different sources: the vital registration system (birth, death and marriage certificates), and the various elements of the municipal population registration (population registers, personal cards and Municipal Basic Administration).

[3] This divide can only be understood by taking into account the complicated geological, economic and social situation of the various provinces. Almost the whole of Zeeland, the western part of Utrecht and the western part of Friesland are situated less than one meter above or even below sea level. This geological situation not only caused a high incidence of malaria, it also resulted in salinisation of the surface and ground water wherever seawater could penetrate inland. The consequences were a lack of water acceptable for household purposes and the enforced use of contaminated surface water. In the East and South of the country, good ground water was generally available in wells. The varying nature of human occupation, in itself also dependent on the geography of the country (land use, urbanisation, farm type, road and water network) also had an effect on mortality. An example is the high population density in the old Dutch cities.

[4] Zeeland in the Southwest is for a large part below sea level. It is protected by a system of river- and sea-dikes and consists of a strip of the Flanders mainland, bordering to Belgium and six former islands. None of these has preserved a true insular character as they are now all connected to each other or to the inland province of Noord-Brabant and to Zuid-Holland by dams and bridges. Zeeland is characterised by specific relief, drainage, soil and accessibility that had a profound effect on the types of settlement, reclamation methods, shapes of fields and farms, land use and communications (Lambert 1985, pp. 5-6). The province had and has few industries and no large towns. It was for a long time a rural area with sea-clay grain-farming where in the second half of the nineteenth century agricultural modernisation was eroding the position of the small farmer and farm labourer (Wintle 1985; Priester 1998). Part of the population was involved in the fishing industry. The economy of the region started to change after 1900. Tourism developed on a small scale from that time on, gaining importance after WW I, but in particular after WW II. After 1900 also industrialisation took place, in particular in Zeeuws-Vlaanderen and Walcheren. After the end of WW I textile and chemical industry became more and more important but the industrialisation did not result in urbanisation of the area.

The collection of information on the life histories of the sampled individuals started with the birth certificates, giving information on day and hour of birth, the address at which the child was born, sex, and Christian name of the child and, for the parents, surnames and Christian names, occupation, marital status of the mother, municipality of residence, and father's ability to sign the birth certificate.

By following the new-born child in the consecutive population registers, and, in case of migration, in the population register of the new place of residence, the complete life history and the migration history of the selected individuals could be reconstructed till death. Continuous population registers are available from 1850 on, and they combine census listings with vital registration in an already linked format for the entire population of each municipality from 1850 till 1939. In most municipalities, registers cover a time span of ten years between the censuses. For each household member, the registers record the date and place of birth, relation to the head of the household, sex, marital status, occupation and religion. New household members such as live-born children arriving after the registration had started were added to the list of individuals already recorded, and those moving out by death or migration were deleted with reference to place and date of migration or date of death. Residents were also required by law to report migration between communes at both the origin and destination. The registers make it possible to track the new-born down from household to household and from place to place. Individuals can, in principle, thus be followed on a day-by-day basis for a long period.

In the 1930s, the individual person became the registration unit in all municipalities. Since then, the population register in each municipality consisted of a collection of personal cards, containing nearly the same information as the population register. All persons who were alive in 1939 or were born after that year received a Personal Card. At the moment of death, this card is removed from the files and sent to the Central Bureau of Statistics, and later on sent to the Central Genealogical Bureau. Personal cards of all persons who died between the 1st of January 1940 and the 30th of September 1994 are available for research. For persons who died after that date, extracts from the so-called *Gemeentelijke Basis Administratie* (GBA: Municipal Basic Administration) can be collected at the Central Genealogical Bureau, containing almost the same information. The Municipal Basic Registration contains personal data of all persons living in The Netherlands. For persons still alive, information from the Municipal Basic Administration can be provided by the individual municipalities. The information from the population registers and its successors make it possible to reconstruct the composition and structure of the households in which the person lived from birth till death.

Of course the registration system in particularly during the nineteenth century has also serious shortcomings. For various reasons it will be impossible to reconstruct the life course of numerous individuals from the sample. For sev-

eral municipalities the population registers were burned, lost during floods or destroyed during WW II. Numerous persons left their place of residence without a correct registration of their place of destination. Many people left the Netherlands making it very hard to follow them in their new country of destination. Although in all these cases the complete reconstruction of the life course is problematic, it does not imply that no useful information about the individuals concerned is available. First of all, for those persons who had left their municipality of residence with an unknown destination and who had died after 1939, the life course could be reconstructed retrospectively from either the personal card or from the extract of the Municipal Basic Administration. Both sources contained retrospective information that made it in many cases possible to study the life course backwards in time. Secondly, consultation of the vital registration system very often gave information on the place and date of death, the place and date of marriage of the person concerned or the place and date of birth of its children. In these cases as well for those who had left with unknown destination the life course could be reconstructed backwards.[5] Thirdly, part of the individuals that left the country can and will be followed to their new destination. The vital registration systems of Belgium, Germany and the Dutch East Indies and shipping lists and censuses for the USA might be used to collect information on these migrants.

Table 1 shows the number of births in the sample, and the number of births for which a date and place of death was found by birth cohort. In the two oldest cohorts the date of death was available for around 79% of all births; in the more recent cohort, this applies to 69% of the cohort. A considerable proportion of births in the two oldest cohorts died already before age 18. This percentage decreased considerably in the more recent cohort. Children for whom no date of death is available until now, could be followed only to their mid-twenties, and in the more recent cohort only to their early twenties. For the more recent cohorts, of which a considerable part is still alive, information on survival will be available in a later stage by making use of the municipal basic administration. Migration to other countries caused a considerable loss to follow up: for 152 of the 2,088 individuals, a migration destination outside the Netherlands is known: 70 migrated to neighbouring Belgium, 81 to the USA

[5] More and more electronic databases with information on death and marriage records from the vital registration system have been placed on the Web. *Genlias*, a joint initiative by a number of public archives in the Netherlands, is a national database that allows one to search the data from the open vital registers for the Netherlands. Ultimately Genlias will contain information on deaths and marriages for the periods 1812-1952, respectively 1812-1922 and births for the period 1812-1902. Complete (or almost complete) series of marriages are already placed on the Web for all Dutch provinces with the exception of Zuid-Holland and Noord-Holland (although for these provinces as well data in electronic databases are available for various cities and regions). For Friesland and Zeeland, and for parts of the provinces of Overijssel, Drenthe, Limburg and Friesland death certificates are placed on the Web as well.

and Canada, and ten to the Dutch East Indies. Only part of them will be followed further (this has been done already for five people who died in Belgium and Germany).

Table 1: Number of deaths observed by age at death and number of censored individuals by age at last observation, by birth cohort.

		Birth cohort			
		1850-1874	1875-1899	1900-1922	Total
No death observed	N	171	112	194	477
	%	20.6	17.6	31.1	22.8
Death observed	N	659	523	429	1,611
	%	79.4	82.4	68.9	77.2
Of which below 18	N	355	168	104	627
In % of total deaths	%	53.8	32.1	24.2	38.9
Total	N	830	635	623	2,088
	%	100	100	100	100
Average age at last observation for persons whose age at death is not available					
No death observed	N	171	112	194	477
	Age	23.55	25.88	19.08	22.28

Migration was also very frequent for those who remained in the country. A good indication is the place of death of the sampled individuals. A rather high and growing percentage of deaths took place outside the province of birth: 9% in birth cohort 1850-1874, 19% in birth cohort 1875-1899 and 17% in cohort 1900-1922. The majority of those migrants died in the big cities in the western part of the Netherlands.

Social class and household situation of the sample

Given the historical character of our study and the sources available, we are confronted with serious restrictions regarding the collection of information on exposure to health-threatening factors during childhood and effects of these factors on adult and later life.

The main health outcome that we study is survival after age 18. The socio-economic situation, the family situation and the region of residence of the child are measured during the first fifteen years of its life.

To study the influence of adverse socio-economic circumstances on survival, we will use information on the economic position of the child's family at

several points in time between birth and adolescence.[6] In addition to the direct effects of the socio-economic background of the child, we will also study the indirect effects on longevity, working through the effect which the child's background might have on his/her socio-economic status established later in life (Hummer, Rogers and Eberstein 1998). Survival to adulthood and old age will be viewed as a function of current and past socio-economic conditions and we will try to determine empirically the weights of these conditions.

It is important to use a social class categorisation that is applicable to the whole time period and that might be used as an indicator of people's potential to affect one's own life chances and destiny - or 'life chances' - through control of (scarce) resources. We followed the approach to the coding and classifying of occupational data recently proposed by Van de Putte and Miles (2002). Their method is based on one hand on a recently developed coding scheme called the HISCO (*Historical International Standard Classification of Occupations*) occupational scheme (van Leeuwen, Maas and Miles 2002) which translates occupational descriptions covering a long historical time, various languages and countries in a common code, compatible with the International Labour Organisation's *International Standard Classification of Occupations* (ISCO68) scheme. On the other hand use is made of a newly-developed translation of these historical occupational titles into a social class scheme, called the SOCPO (Social Power) scheme. The scheme is underpinned by a theory of social organisation, of which 'social power' is the fundamental organisational principle. Social power is defined as the potential to influence one's destiny - or 'life chances'—through control of (scarce) resources and is based on economic and cultural resources (Scott 1996; Erikson and Goldthorpe 1993, pp. 39-40).[7]

The merging of economic and cultural power dimensions leads to a scheme with five levels. In level five are included executives, having general policy tasks, supra-local businessmen, non-manual super-skilled and members of the nobility; in level four supervisors of skilled workers, local businessmen, manual super skilled and non-manual skilled people; in level three supervisors of semi- and unskilled workers, and manual skilled workers; in level two the self-employed who are locally oriented and have a minimal capital and the semi-skilled workers, and in level one the unskilled workers. We denote these groups as respectively the elite, the middle class, the skilled workers, the semi-skilled

[6] The information on the socio-economic status is limited to information on the occupation of the parents and the individual itself: although there is a strong correlation between indicators of parental socio-economic status such as education, occupation and income, each variable partly reflects also a distinct aspect of the childhood environment (Gilman 2002).

[7] We wish to thank Dr. Andrew Miles (University of Birmingham) and Dr. Bart van de Putte (University of Louvain) for invaluable help with the coding of the occupational titles. Dr. Marco van Leeuwen (International institute for Social History, Amsterdam) put the basic coding list of HISCO to our disposal.

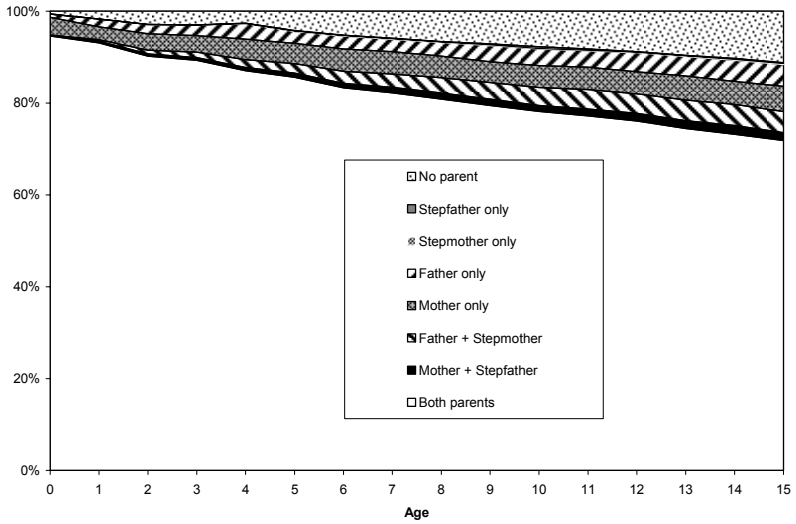
workers, and the unskilled workers. Parents from the first group made up only two percent of the sample, middle class parents 28 percent, skilled workers 12 percent, semi-skilled 11 percent, and unskilled workers 45 percent.

To analyse the structure and composition of the family in which children grew up and their effects on survival later in life, we will record the marital status of mother and father at the time of the child's birth and the family composition during the life of the child. Although it can be expected (given the relatively high mortality rate in 19th century Dutch society) that a sizeable proportion of all children spent at least a part of childhood without one or both parents, little is known about the household structures children grew up in. We use information on entry, exit and death of members of the household from the population registers to reconstruct to what extent children up till age 15 lived with their natural parents or with stepparents. This categorisation allows us to compare the survival of children of unwed mothers, of children born to widows and of children who lost one or both of their parents later in life with the survival of children born and raised in complete families. We can also pay attention to reconstituted families. Here we can in principle not only focus on direct effects but also study indirect effects, working through the effect of family structure on socio-economic status reached later in life.[8]

At each exact age from age 0 to age 15 we determined in which of eight possible household structures children were residing. These eight household forms were: (1) with both natural parents, (2) with their mother and a stepfather, (3) with their father and a stepmother, (4) with their mother only, (5) with their father only, (6) with a stepmother only, (7) with a stepfather only, and (8) without any parent or stepparent. Each of these household forms could include additional household members. Figure 1 presents the proportion of children residing in each of the eight selected household forms until age 15.

[8] To study whether survival is determined by influences stemming from the region of residence during childhood, survival among migrants will ultimately be compared with survival of non-migrants from the region of origin and with those of the native population of the region of destination (Brockerhoff 1994). To study the long-run impact of the socio-historical context in which individuals spent their childhood, measures of infancy and childhood experiences have been constructed at the community level. These factors include data on crude death rates and infant mortality rates, regional income levels, water supply, the character of the agricultural system etc.

Figure 1: Distribution of children by household situation between birth and age 15



At birth the large majority (95%) of children lived in a household that contained both natural parents. The only other household structure of some importance at birth was a mother-only household. About five percent of children were born into a household in which the natural father was lacking. In many cases, these were illegitimate children raised in the mother's parental household. The proportion of children living in an 'intact' family decreased steadily with age of the child. At age 15, more than one quarter (28%) was not living with both natural parents anymore. Less than two percent of all children were living with a mother and a stepfather at any time until age 15. The maximum proportion living with a father and a stepmother was somewhat higher (four percent), not surprising given the higher frequency of remarriage among widowers than among widows. Living in a one-parent household was more common during childhood than living in a stepfamily. At age 15, five percent of all children were living with their mother only and an additional five percent were living in a lone-father family. Living with a stepparent only was very uncommon among children in the second half of the nineteenth and the early years of the twentieth century. Finally, living with no parent at all was very uncommon at birth, but was experienced by more then one out of ten children at age 15.

Childhood family conditions and adult survival

The limited availability of data makes it impossible at this stage to explore the whole range of questions that are central in our project.[9] The analysis is seriously hampered by the small size of the sample currently available. We have information on only 1261 persons who have survived until age 18, and the number of persons who have experienced adverse family conditions during childhood is only a fraction of this total sample. Given the fact that the effects on adult survival are expected to be relatively small (albeit even relatively small effects can have major social importance), it is difficult to obtain statistically significant and reliable effects. Therefore, results should be treated as preliminary and as suggestions for further research on the larger sample rather than as definitive.

We therefore focus in an exploratory way only on the relationship between the family situation during childhood and survival at adult and old age. In addition to that we analyse the relationship between the socio-economic situation in which the child lived and survival at higher ages.

To examine whether and if so to what extent and how the childhood household structure influenced the survival chances of adults, we estimated a series of Cox's semi-parametric regression models on survival from age 18 onwards. In these models, we included controls for sex, social class (father's occupation), parental religion and region of birth. The models vary with regard to the exact indicators of childhood household structures included. The estimated effects for the childhood household structure variables are presented in Table 2.

The first question we addressed is whether persons who have ever experienced a period during childhood in which they lived without both natural parents have different survival chances than people who have always lived with both natural parents. We examined this issue in Model 1 (Table 2). About 30 percent of all persons have ever experienced a childhood spell without both natural parents. We did not find a statistically significant effect of such living conditions on survival chances in adulthood. Starting from the idea that periods without both natural parents can be viewed as periods of relative deprivation experienced by the child, we would expect a negative effect on survival (and a positive effect on the risk of mortality). Persons who have ever lived without both natural parents during childhood have a 10 percent *lower* mortality rate during adulthood than persons who have always lived with both parents until age 15. To explore further the relationship between the various aspect(s) of childhood household structure and survival, we performed a series of additional analyses.

[9] For the same reason, in presenting some provisional outcomes we do not use the community information collected for our study.

Table 2: Effects of various childhood household structure indicators on the mortality rate after age 18 (Cox's regression models).

Model	Variable	Exp (b)	p-value	Variable means
1	Ever lived without both parents before age 15 (dummy)	0.900	0.141	0.30
2	Number of years lived without both parents before age 15 (continuous)	0.988	0.072	2.79
3	Number of years lived with father and stepmother before age 15 (continuous)	0.973	0.074	0.45
	Number of years lived with mother and stepfather before age 15 (continuous)	1.007	0.749	0.17
	Number of years lived with mother only before age 15 (continuous)	0.986	0.332	0.69
	Number of years lived with father only before age 15 (continuous)	0.999	0.971	0.48
	Number of years lived with no natural parent before age 15 (continuous)	0.988	0.248	0.99
4	Without one or more parents before age 1 (dummy)	0.866	0.291	0.07
	Without one or more parents after age 1 (dummy)	0.909	0.214	0.23
5	Without mother before age 1 (dummy)	0.882	0.517	0.04
	Without father before age 1 (dummy)	0.900	0.555	0.06
5 (men)	Without mother before age 1(dummy)	0.602	0.053	0.04
	Without father before age 1 (dummy)	0.962	0.876	0.06
5 (women)	Without mother before age 1(dummy)	1.640	0.095	0.03
	Without father before age 1 (dummy)	0.791	0.393	0.05

In all models, controls for sex, social class (father's occupation), parental religion and region of birth are included.
Statistically significant parameters in bold.

In Model 2 (Table 2) we examined whether it is just the mere exposure of children to households without both parents or the number of years exposed to living without both parents that counts. On average, persons have spent almost three years without both natural parents until age 15. The number of years spent without both natural parents has no effect on the mortality rate, and its *p*-value is just too high to reach significance.

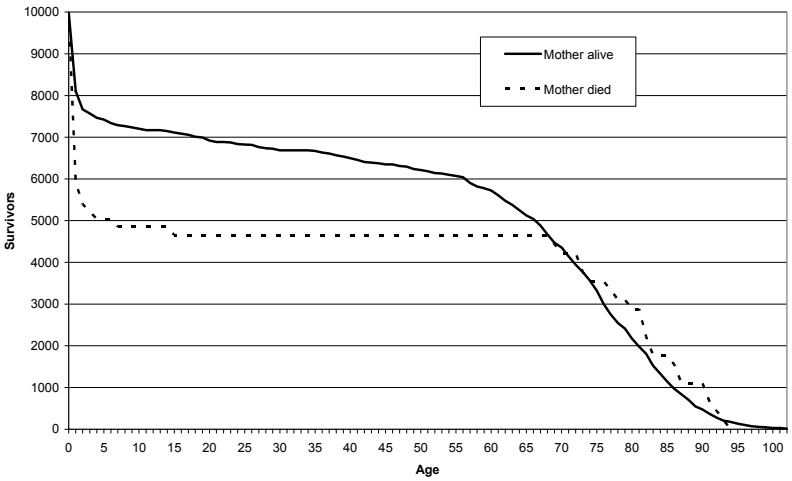
Next, we examined whether the kind of household structure children lived in made a difference. We specified five continuous variables, indicating the number of years children spent with a father and a stepmother, a mother and a stepfather, with mother only, with father only, and with no natural parent. The results of the analysis are presented in Model 3 (Table 2). None of the five

indicators showed a significant effect. In a forth step, we focussed on the timing of loss of parents. It has been suggested that the loss of a parent (and in particular the loss of the mother) during the first year is particularly devastating for the health and the survival chances of their children (Van Poppel 2000). To examine this issue we estimated two further models. In Model 4 (Table 2) we report the effect of being without one or both parents during (part of) the first year of life and the effect of being without parents after the first year. Eight percent of all persons who survived until age 18 had lived without one or both parents during (part of) their first year of life, whereas an additional 22 percent had lived without one or both parents at a certain moment after age 1. Adults who have spent part of their first year without one or both parent were found to have a mortality that did not differ significantly from that of persons who spent their whole childhood with both parents. Adults who spent part of their childhood after their first year of life without a parent also had survival chances as adults that did not deviate from those of children who spent all their childhood in an intact family. In Model 5 we focussed in more detail on the first year by creating two dummy variables, indicating whether adults had lived (part of) their first year without their natural mother or without their natural father. About four percent had spent (part of) their first year without their natural mother, whereas six percent had spent (part of) their first year without their natural father. Having spent part of one's first year without one's natural father or mother had no impact on adult survival of boys and girls taken together. In a final model, we examined whether the relationships found in Model 5 held for both men and women. As the results show, having lived without one's natural mother increased the adult survival chances for men and not for women.[10]

It is not easy to account for this unexpected finding (if one is willing to take it seriously at all). One possible explanation could be that some kind of selection process is at work. Children who were deprived of their mother during the first year of their life run a very high mortality risk during the early years of childhood. It could be that only the strongest survive, and that these have a relatively high chance of survival compared to other adults. The data are to sparse to allow for a thorough test of this possibility, but as a kind of preliminary test, we estimated the survival curves for men who lived part of their first year without their mother (N=62) and those who lived the whole of their first year of life with their natural mother. Figure 2 presents the two curves. They show a pattern that clearly conforms to the selection hypothesis. At young ages, persons who were deprived of their mother during their first year of life run a much higher mortality risk, but the pattern reverses later on. This process is nicely illustrated by the crossing of the two survival curves.

[10] However, one has to notice that the absolute number of persons who had spent part of their first year without their mother and survived until age 18 is very low. This underscores our earlier remark on the need for a larger sample to test these issues much more thoroughly.

Figure 2: Survival curves for men with and without a mother during (part of) their first year of life (per 10,000 live born)



In addition to household structure, a number of other childhood factors has been examined. Attention has been paid to father's occupation, region of birth and parental religion.[11] We present the effects of these factors on adult mortality, based on Model 5 from Table 2. Parameter estimates are presented in Table 3.

As can be seen from Table 3, none of the childhood factors (apart from religion) exerts a statistically significant effect on adult survival. In addition, no effect of year of birth and sex on adult survival is visible.[12]

Contrary to what was observed in other studies, we observed no effect of adverse childhood conditions on survival in later life. This applies in particular to childhood family circumstances, the factor to which we in particular paid attention. The same conclusion however also applies to living during childhood

[11] Since the 1980s a growing body of research on the relation between religion and health has been published (Hummer et al. 1999). Historical studies have also shown a growing interest in the influence of religious factors on mortality. For nineteenth-century Netherlands, a strong relation between religion and infant and child mortality was observed (Van Poppel, Schellekens and Liefbroer 2002). In our study, we distinguished between mainstream Protestantism (Dutch Reformed), Catholicism, Orthodox Protestants and people without religion or with unknown religion. About two-thirds of parents were Protestant, of which 13 percent belonged to Orthodox groups. Twenty-seven percent of all persons were 'born' into a Catholic family. Region of birth was used as a variable because within the province of Zeeland strong differences in particular in infant mortality were observed. A distinction was made between Zeeuws-Vlaanderen, Tholen, Beveland and Walcheren.

[12] However, there are clear effects of year of birth and sex on child survival, with later born children and women having higher rates of survival than earlier born children and men.

in adverse socio-economic conditions or living in areas characterised by extreme mortality risks, reaching values of around 35 percent during the first year of life. This conclusion is a provisional one as the database as it exists at this moment is far from complete. On the one hand, the data-set will be enlarged with around four thousand supplementary births from provinces with completely different living conditions in this year. On the other hand, data collection will continue for those children who have been lost in the follow-up procedure. This will make it possible to reach firmer conclusions than at this moment.

Table 3: Effects of childhood factors on the mortality rate after age 18 (Cox's regression model).

Variable	Exp (b)	p-value
Men (dummy)	1.093	0.175
Year of birth (continuous)	1.001	0.646
Father's occupation: Missing (dummy)	1.550	0.090
Father's occupation: Elite (dummy)	0.908	0.698
Father's occupation: Middle class (dummy)	0.969	0.685
Father's occupation: Skilled workers (dummy)	0.859	0.169
Father's occupation: Semi-skilled workers (dummy)	1.026	0.808
Father's occupation: Unskilled workers (reference category)		
Born in Tholen (dummy)	0.987	0.891
Born in Walcheren (dummy)	1.047	0.603
Born in Beveland (dummy)	1.124	0.276
Born in Zeeuws-Vlaanderen (reference category)	0.947	0.623
Parents religion: Roman Catholic (dummy)	1.023	0.797
Parents religion: Orthodox Protestants (dummy)	0.997	0.973
Parents religion: No religion or no info (dummy)	**1.602**	0.001
Parents religion: Mainstream Protestant (reference category)		
Without mother before age 1 (dummy)	0.882	0.517
Without father before age 1 (dummy)	0.900	0.555

Statistically significant parameters in bold.

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